

Office of External Relations

International Participation in Lunar Exploration

Presentation to the Robotic and Human Lunar Exploration Strategic Roadmap Federal Advisory Committee

January 24, 2005



Briefing Objectives

- Review major non-US lunar missions and international working groups
- Review the overall outcomes of and general observations from the November 2004 "International Workshop on Creating New and Sustainable Space Exploration"
- Review the specific outcomes from the Breakout Session on Robotic Missions to Support Human Missions
- Provide status on next steps



Major Non-US Lunar Missions

- Europe: European Space Agency SMART-1 (Small Missions for Advanced Research and Technology) Mission
 - Launched September 27, 2003, entered lunar November 15, 2004, 2-2.5 year mission
 - Major Objective: Technology demonstration mission to flight test Solar Electric Primary Propulsion for future larger missions
- Japan: Japanese Aerospace Exploration Agency SELENE (SELenological and Engineering Explorer) Mission
 - Launched planned for HII-A in 2006; consists of a main orbiter and two subsatellites with 14 science instruments
 - Major Objectives: to obtain scientific data of the lunar origin and evolution and to develop technology for future missions
- Japan: Lunar-A
 - Delayed to 2010
 - Major objective: seismology using penetrators
- India: Indian Space Research Organization Chandrayaan-1 Mission
 - Planned launch in 2007/08; 100 km X 100 km Lunar Polar Orbit; 2 year mission
 - Major Objectives: High-resolution remote sensing of the lunar surface features in visible, near infrared, X-ray and low energy gamma ray regions



Major Non-US Lunar Missions cont.

Russia: Russian Federal Space Agency Luna-Glob Mission

- Planned launch for 2008-2015 on Soyuz-2/Fregat; consists of orbiter, lander and 2 penetrators
- Major Objectives: Investigate moon internal structure; soil samples return; and lunar resource utilization

China: Chang'E Lunar Satellite

- Planned launch date 2007; 200km circular polar lunar orbit; 1 year life-time
- Major Objectives: Obtain lunar surface three-dimensional stereo image; analyze distribution of useful elements and estimate abundance; survey thickness of soil and evaluate resource of He-3; and explore space environment between the Earth and moon



Existing and planned (International) Working Groups

International Lunar Exploration Working Group (ILEWG)

- Chartered and meets periodically
- Dominated by ESA, India, Japan and China, but Canada, Russia, and the U.S. also participate
- U.S./NASA participation typically at a lower, science level

The Lunar Exploration Analysis Group (LEAG)

- In the process of getting chartered
- Format will be similar to the Mars Exploration Program Analysis
 Group (MEPAG) where membership and participation will be open to all interested parties, including all internationals



International Workshop on Exploration Systems

- November 2004: met objectives of providing a forum for NASA and 18 other space organizations to exchange information on plans for space exploration and to begin a process of identifying areas of potential collaboration
- Five breakout sessions on technical and programmatic topics identified 23 initial actions to be completed by August 2005
 - Process to identify and position ourselves to pursue areas of greatest interest and Return on Investment
- Workshop also identified the traditional guidelines for international cooperation as well as new ways of doing business
 - Opportunities and challenges to international cooperation were listed



General Observations and Actions from Workshop

- Widespread interest in developing a core competencies matrix for exploration (Action: all agencies to fill out matrix indicating areas of interest)
- Agreement to share roadmaps (Action: conduct an initial evaluation of individual roadmaps for synergy with strategy and Vision for U.S.
 Space Exploration; based on findings, suggest the best mission sets for a cooperative program)
- Agreement that current international working groups should be utilized, combined, or disbanded depending on synergy with exploration goals (Action: assess charters for synergy with exploration goals and adequate international participation)
- Interest in identifying near-term technology opportunities for collaboration



Outcomes from Lunar Breakout Session

- Lunar exploration covered in breakout session on "Robotic Exploration Objectives to Support Human Missions"
- 10 agencies participated

ASI Simonetta Di Pippo

CONAERoberto Alonso

CSA Pierre Allard William Harvey

CNES
 Richard Bonneville

– DLR Juergen Drescher

– ESA Bruna Gardini

JAXA Kohtaro Matsumoto

Roskosmos Konstantin Pichkhadze Artem Ivankov

– UK (BNSC)David Parker

UkraineOleg Fedorov

 Breakout session identified all capabilities, missions, instruments of interest and top 3 items on interest to NASA/international partners for Exploration



Key Observations from Breakout Session

- Mars is the central exploration focus for nearly all countries
 - Most countries haven't identified the Moon as stepping stone to Mars in their strategic planning (with robotic precursors)
 - Current planning in countries other than the U.S. is driven by the science priorities developed within their own science constituencies and the global marketplace
 - Mars Sample Return was the highest Mars priority in general
- Most countries are application-driven
 - their missions and products have to be traced to specific technologies with clearly-defined societal benefits
- A large amount of technology development will be required to enable exploration
 - There are a lot of relevant technologies that are planned or being developed that will be extremely valuable to exploration
- Everyone is excited about the potential for true collaboration
 - This workshop is a good first step engaging potential partners before plans are set in stone
 - We need to learn the lessons from past collaborative efforts



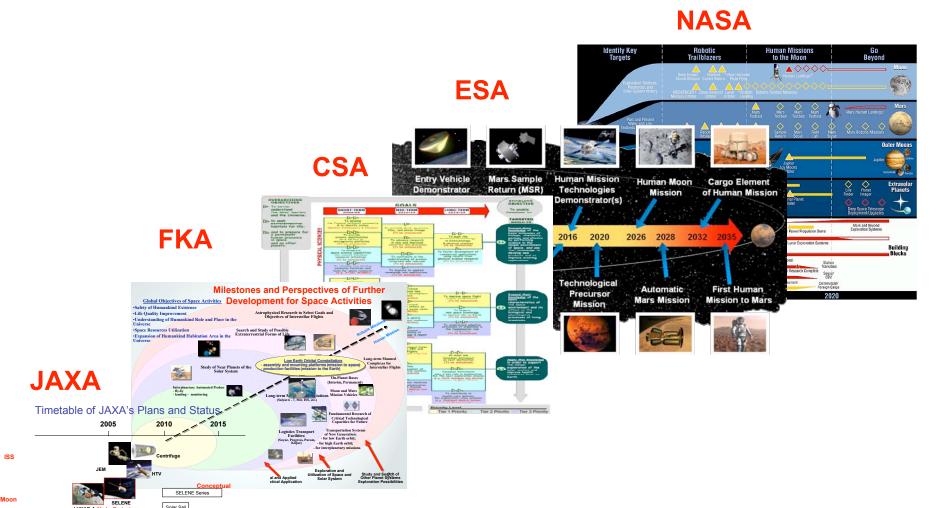
Key Observations cont.

- There are many robotic missions planned to both the Moon and Mars
 - Collaboration on key missions such as Mars Sample Return is advantageous for all
- Sharing of data from missions is essential to moving forward in a collaborative way
 - This is an area where innovative new practices could be of great benefit to Exploration



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Next Steps: Assessing Roadmaps



Individual Roadmaps are being assessed with respect to the Vision for U.S. Space Exploration



Next Steps for International Lunar Missions

- Science Mission Directorate International Workshop on Science Exploration, March 8-10, 2005
 - Further information on NASA and international partner roadmaps
- Follow-up on Exploration Systems Workshop actions by Aug 05:
 - Work with Planetary Data System (PDS) community and others to determine strategy for common access to mission data
 - Engage key agencies in roadmapping activity to suggest the best mission sets for a cooperative program (Common action with Session 1)
- Pursue international opportunities where there is mutual benefit and the cooperation is consistent with U.S. foreign policy goals and regulations in:
 - Avoiding unique development costs, where technology and/or infrastructure already exists
 - Maximizing the effectiveness of ESMD acquisition development programs by gaining broader access to advanced human and robotic technology and development programs and demonstrations, and readily available industrial infrastructure
 - Pooling of international technical competencies to offer greater potential for innovation, and an expanded community of scientific researchers to realize greater science yields



Backup Slides

International Participation in Lunar Exploration



November International Workshop Participants

- CONAE (Argentina)
- CSIRO (Australia)
- CSA (Canada)
- CNSA (China)
- European Community
- ESA (Europe)
- CNES (France)
- DLR (Germany)
- HSO (Hungary)
- ISRO (India)

- ISA (Israel)
- ASI (Italy)
- JAXA (Japan)
- KARI (Korea)
- Roscosmos (Russia)
- INTA (Spain)
- NSAU (Ukraine)
- BNSC (UK)
- NASA (USA)



November International Workshop Process

- Series of briefings from selected agencies
- 5 workshops covering:
 - Human Exploration Objectives, Strategy, and Objectives
 - Robotic Exploration Objectives to Support Human Missions
 - Human Missions and Systems beyond LEO
 - Exploration Systems Research & Technology Development
 - Approaches for International Collaboration
- Panel discussions and conclusions
- Panel outbriefs



November Break-out Process

10 agencies participated

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- 9 agencies presented in addition to NASA
 - Presentations covered each agency's areas of expertise and interest in Lunar and Mars robotic missions as well as space weather monitoring and prediction (NEO's?)
- Summary spreadsheet captured all capabilities, missions, instruments of interest and top 3 items on interest to us/them for Exploration were identified (included in these slides).
- Discussions occurred regarding the measurements, technologies, infrastructure required for robotic precursors. In addition, we discussed the barriers to and potential solutions for collaboration on these efforts.



Actions from Breakout Session

- Dec 04 Summarize the capabilities matrix, and confirm with each of the agencies
- Jan 05 Assess current working group charters for synergy with Exploration and to ensure adequate International participation
- Feb 05 Discuss with Science Mission Directorate to ensure that their Mar 05 international workshop objectives are synergistic with Exploration's
- Apr 05 Identify bi-lateral discussions regarding key capabilities
- Aug 05 Work with Planetary Data System (PDS) community and others to determine strategy for common access to mission data
- Aug 05 Engage key agencies in roadmapping activity to suggest the best mission sets for a cooperative program (Common action with Session 1)



Matrix Example from Lunar-Mars Working Group

